

CLAIMS

1. Apparatus for assaying an analyte in a body comprising:

at least one light source implanted in the body controllable to illuminate a tissue region in the body with light at at least one wavelength that is absorbed by the analyte and generates thereby photoacoustic waves in the tissue region;

5 at least one acoustic sensing transducer coupled to the body that receives acoustic energy from the photoacoustic waves and generates signals responsive thereto; and

a processor that receives the signals and processes them to determine a concentration of the analyte in the illuminated tissue region.

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2. Apparatus according to claim 1 and comprising:

at least one acoustic transmitting transducer coupled to the body controllable to transmit ultrasound;

a controller adapted to control the at least one transmitting transducer; wherein

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the controller controls the transmitting transducer to transmit ultrasound that is incident on the illuminated tissue region and thereafter on the at least one sensing transducer and the processor processes signal generated by the sensing transducer responsive to the ultrasound to determine a change in an acoustic property of the tissue region caused by the illumination and therefrom an assay of the analyte.

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3. Apparatus for assaying an analyte in a body comprising:

at least one light source implanted in the body controllable to illuminate a tissue region in the body with light at at least one wavelength that is absorbed by the analyte and generates a change in an acoustic property of the region;

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at least one sensing acoustic transducer that generates signals responsive to acoustic energy incident thereon;

at least one transmitting acoustic transducer that transmits ultrasound that is incident on the region and thereafter on the sensing transducer; and

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a processor that receives signals generated by the sensing transducer responsive to the incident ultrasound and processes them to determine a measure of the change and therefrom concentration of the analyte.

4. Apparatus for assaying an analyte in a body comprising:

a membrane formed from a material permeable to interstitial fluid in the body and the analyte therein that bounds a volume region in the body, which volume region contains interstitial fluid that permeates through the membrane to enter the volume;

5 at least one light source implanted in the body that illuminates the volume with light at at least one wavelength that is absorbed by the analyte and generates thereby photoacoustic waves in the volume;

at least one acoustic sensing transducer coupled to the body that receives acoustic energy from the photoacoustic waves and generates signals responsive thereto; and

10 a processor that receives the signals and processes them to determine a concentration of the analyte in the illuminated volume.

5. Apparatus for assaying an analyte in interstitial fluid in a body comprising:

at least one light source implanted in the body that provides light at at least one wavelength that is absorbed by the analyte;

15 at least one photosensor implanted in the body that receives light from the at least one light source and generates signals responsive thereto;

at least one membrane formed from a material permeable to components of interstitial fluid in the body and the analyte that bounds a volume sandwiched between the at least one light source and the at least one photosensor and wherein the light from the at least one light source that reaches the at least one photosensor propagates through the volume; and

20 circuitry that receives the signals from the at least one photosensor and uses them to provide an assay of the analyte in the body.

6. Apparatus according to claim 5 wherein a gap between the source and the sensor is 10
25 to 50 micrometers.

7. Apparatus according to claim 5 wherein a gap between the source and the sensor is 50 to 150 micrometers.

30 8. Apparatus according to any of claims 1-7 wherein the absorption coefficient for light in tissue in the region at a wavelength of the at least one wavelength is substantially equal to the sum of the absorption coefficients of the analyte and at most a relatively small number of additional analytes.

9. Apparatus according to claim 8 wherein the at least one additional analyte comprises a number of analytes less than or equal to three.

10. Apparatus according to claim 8 wherein the at least one additional analyte comprises a 5 number of additional analytes less than or equal to two.

11. Apparatus according to claim 8 wherein the at least one additional analyte comprises one additional analyte.

10 12. Apparatus according to any of claims 8-11 wherein the at least one additional analyte comprises water.

13. Apparatus according to any of claims 1-12 wherein the at least one implanted light source is encapsulated in a capsule having an aperture substantially transparent to light at the at 15 least one wavelength through which light is transmitted to illuminate the region.

14. Apparatus according to claim 13 and comprising a layer of a biocompatible material overlaying the aperture that promotes vascularization of tissue in close proximity to the aperture and wherein the region comprises the vascularized tissue.

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15. Apparatus according to claim 14 wherein vascularization is promoted at distances from the aperture that are less than an extinction length for light at the at least one wavelength.

25 16. Apparatus according to claim 13 or claim 15 wherein the capsule comprises a receiver for receiving energy to power the at least one light source.

17. Apparatus according to claim 16 wherein the receiver comprises an antenna for receiving electromagnetic energy.

30 18. Apparatus according to claim 17 and comprising a transmitter external to the body that transmits electromagnetic energy to the antenna.

19. Apparatus according to any of claims 16-18 wherein the receiver comprises an acoustic transducer for receiving acoustic energy.

20. Apparatus according to claim 19 and comprising an acoustic transmitter external to the body that transmits acoustic energy to the acoustic transducer comprised in the receiver.

5 21. Apparatus according to any of the preceding claims wherein the analyte is glucose.

22. Apparatus according to any of the preceding claims wherein the at least one wavelength comprises a wavelength equal to about 9.66 microns.

10 23. Apparatus according to any of the preceding claims wherein the at least one wavelength comprises a wavelength equal to about 9.02 microns.

24. Apparatus according to any of the preceding claims wherein the at least one wavelength comprises a plurality of wavelengths.